LESSON 1: URBAN FOREST RECYCLING

Lesson at a Glance

Grades
- 3-5

Duration
- 2 hours
- Additional time for students to conduct tea bag decomposition investigation over 2 weeks

Standards
Arizona Science Standards
- 3.L2U1.6
- 3.L2U1.7
- 3.L2U1.8
- 5.L4U3.11

All standards listed at end of lesson

Suggested Sites
- Classroom
- Community or school garden compost pile
- Leaf litter under trees in park
- Worm farm

Overview

Students will learn about interactions between living and nonliving components of the urban forest by exploring basic energy flow and nutrient cycling through the three main types of urban forest organisms (producers, consumers, decomposers). They will investigate these organisms in a compost sample, focusing on decomposition and how decomposition brings together living and nonliving components. Students will conduct a two-week experiment by filling a small zipper bag with soil and a tea bag, and recording changes as the tea bag decomposes.

Objectives

Students will be able to:
- List examples of and sort organisms into producers, consumers, and decomposers
- Record observations about the elements of a compost sample
- Describe the process of decomposition and its importance for nutrient recycling in both natural and urban areas

Background Information

Green plants are called producers because they make their own food with energy from the sun, carbon dioxide from the air, and water through a process called photosynthesis. Organisms that cannot produce their own food are called consumers. Organisms that cannot produce their own food are called consumers.

Background Information (Continued)

Decomposers are specialized consumers that acquire their food from dead organic matter. They break down plant and animal debris, releasing limiting nutrients needed for new growth by producers and other consumers. Fungi and bacteria are the primary decomposers and therefore critical actors in nutrient recycling.

In contrast to nutrients, energy is not recycled in ecosystems. As energy rich organic compounds are produced, consumed, and broken down by organisms, energy flows through organisms and back to the environment. Some of the energy initially captured from sunlight during photosynthesis is used to support life processes, but much of it is lost as heat. Producers constantly convert energy from the sun into chemical energy that fuels the life processes in an ecosystem.

Preparation

Vocabulary

- **Photosynthesis:** process that transforms light energy from the sun, carbon dioxide from the air, and water from the soil into energy rich food. Producers use photosynthesis
- **Producers:** organisms that produce energy rich organic compounds by capturing light energy through photosynthesis; examples are green plants, algae, and some microorganisms
- **Consumers:** organisms that obtain their energy and nutrients by consuming plants or other organisms
- **Decomposers:** organisms that obtain their energy by breaking down dead material and waste derived from other organisms
- **Decomposition:** process that breaks down organic material into mineral nutrients, carbon dioxide, and water
- **Fungi:** group of organisms that break down dead plant and animal matter for food
- **Bacteria:** single-celled, microscopic organisms abundant in all natural environments; many bacteria are decomposers

Materials

For the class:

- Fresh, living compost or soil with partially decomposed organic matter (not store bought); enough to partially fill one shallow pan or plate per team

Per student team:

- Magnifying lens
- Small paintbrush to remove debris
- Paper plate or similar surface to place compost sample

- Tweezers or small sticks

Per student:

- Paper and writing/drawing utensils to record observations
- Optional: Gloves for students to wear while examining compost
- Quart-size zipper bag
- One paper tea bag with herbal tea (e.g., chamomile or mint)

Set-Up

- One week prior to the lesson, contact a local farm, garden, or composting facility to order soil/compost for student investigations.
- Day of the activity, place materials for each team and each student at group work spaces.

Lesson Procedure

Engagement

- Begin with a discussion of the relevant vocabulary: consumers, producers, and decomposers. Play clips from this video, The Food Chain for Kids.
- Consumers:
    - Share how every living thing needs *energy* and *nutrients* to survive. Living things can include people, other animals, plants, fungi, etc.
    - Discuss: How do we get our energy and nutrients? What types of things do you like to eat (consume)?
    - Discuss: What might animals (birds, insects) in an urban forest consume to get energy and nutrients?
    - Describe that since humans and other animals have to eat (consume) to survive, they are categorized as **consumers**.
- Producers:
    - Discuss: We have ideas about how people and other animals might get energy and nutrients, but what about trees and other plants? What do they consume?
    - Share how trees and plants use sunlight, carbon dioxide from the air, water, and nutrients from the soil to produce their own energy. This process is called **photosynthesis**.
    - Describe that since trees and other plants produce their own energy, they are categorized as **producers.**
- Decomposers:

- Discuss: What happens when leaves or branches fall off a tree in a forest? Do they disappear? Where might they go?
- Share that the leaves break down over time with help from organisms called **decomposers.** These organisms consume plants and other things that are no longer living. Flies eating a rotting apple or piece of fruit is a common example of decomposers in action.
- Optional: Play the Decomposers Song for your students and/or the "Dirt on Decomposers" video.

Exploration

- Inform students that they will be examining producers, consumers, and decomposers in action using compost.
- Divide students into teams to investigate a compost sample.
- Describe the materials provided to each student and team:
  - Tweezers for picking up items
  - Brush for dusting/cleaning off items
  - Magnifying glass for "zooming in" on items
- Provide 10-15 minutes for students to examine their compost sample. Students can record observations using their senses on a sheet of paper, prepared worksheet, or in a nature journal.
  - Remind students that they will not be using their sense of taste to observe the compost.
- Use an online resource like Compost Critters to assist students in naming organisms they may find in their compost samples.

Explanation

- After students finish examining their compost sample, provide an opportunity for each group to share their findings aloud with the class.
- As students are listing what they observed, write their observations on the board. Begin to make categories or themes based on what they share.
  - Discuss: What was the most/least common observation? What surprised you? What are you still wondering about?
- Share that decomposers are very important in the environment, including our urban forests. They help to break down everything, from leaves and tree branches to animals or insects that have passed away, keeping the environment healthy. The waste decomposers break down turns into soil, providing nutrients to grow more trees and plants (producers) that then provide energy and nutrients to consumers. It is a cycle!

- Set aside 5-10 minutes for students to wash hands after examining the compost samples. If students wore gloves, discard the gloves and provide hand sanitizer to students.

Elaboration

- Continue the discussion of decomposers, producers, and consumers in an urban forest. While it may be challenging to find compost critters in areas with a lot of buildings and concrete, very small organisms (microorganisms) can live in cracks in sidewalks and in the soil/dirt in empty lots to help continue the decomposition cycle in cities.
- Provide each student with the materials for their personal compost experiment:
    - Ziplock bag
    - Small handful of compost
    - Moist tea bag
- Over the next two weeks, take a few minutes to observe the decomposing tea bag each date. Students can record observations in a nature journal or on a lab worksheet.

Evaluation

- Throughout the two weeks discuss student observations of changes in the tea bag over time.
- At the end of the experiment students can turn in their nature journals to be reviewed. Alternatively, ask students to pick 1-2 journal entries to edit with any additional written details or drawings to turn in to be reviewed.

Additional Resources

Educator Resources and References

- Video: Decomposers Song https://www.youtube.com/watch?v=WLk-9ib0OVA&list=RDCMUCJjstNDkwktHyvUdtcBfb2g&index=1
- Video: The Dirt on Decomposers https://www.youtube.com/watch?v=uB61rfeeAsM
- Video: Selected Invertebrates of the Soil Food Web https://www.youtube.com/watch?v=XqRLVUtAAV8
- Photos: The Ground Crew https://projects.ncsu.edu/cals/course/ent525/soil/soilpix/index.html
- Global Soil Biodiversity Atlas (free download): https://esdac.jrc.ec.europa.eu/content/global-soil-biodiversity-atlas#tabs-0-description=0 This is a reference book with many

photographs of soil organisms and maps of their distribution.

Field Trip Sites and Career Exploration

- Soil scientist, a scientist who studies and analyzes soils to determine how to best use the land in a certain area
    - NCSU Career Guide: https://cals.ncsu.edu/crop-and-soil-sciences/news/what-does-an-environmental-soil-scientist-do-career-guide/
- **Central Arizona:** Arizona Worm Farm https://arizonawormfarm.com/
- **Southern Arizona**: INCH BY INCH https://inchbyinchaz.com/

Arizona State Science Standards

Disciplinary Core Ideas	Crosscutting Concepts	Science and Engineering Practices
Organisms require a supply of energy and materials for which they often depend on, or compete with, other organisms. Scientists explain phenomena using evidence obtained from observations and or scientific investigations. Evidence may lead to developing models and or theories to make sense of phenomena. As new evidence is discovered, models and theories can be revised.	Patterns, Cause and Effect, Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Structure and Function; Stability and Change The unity and diversity of organisms, living and extinct, is the result of evolution. Applications of science often have both positive and negative ethical, social, economic, and/or political implications.	Develop and Use Models; Plan and Carry Out Investigations Use Mathematics and Computational Thinking Obtain, Evaluate, and Communicate Information

Standard Codes	• 3.L2U1.6 • 3.L2U1.7 • 3.L2U1.8 • 5.L4U3.11

Next Generation Science Standards

Disciplinary Core Ideas	Crosscutting Concepts	Science and Engineering Practices
Text	Text	Text

Standard Codes	• Here

Arizona English and Language Arts Standards

Reading: Literature	Reading: Informational Text	Writing	Speaking & Listening	Language
Text	Text	Text	Text	Text

Standard Codes	• Here

Arizona History and Social Science Standards

Civics	Economics	Geography	History
Text	Text	Text	Text

Standard Codes	• Here

Arizona Mathematics Standards

Operations & Algebraic Thinking (OA)	Number & Operations in Base Ten (NBT)	Number & Operations —Fractions (NF)	Measure-ment & Data (MD)	Geometry (G)	Standards for Math-ematical Practices (MP)
Text	Text	Text	Text	Text	Text

Standard Codes	• Here